

WHAT IS CLAIMED IS:

1. A liquid-crystal display device comprising:  
a light pipe including light output means formed on an upper surface of said light pipe;

5 a light source disposed near to an incident side surface of said light pipe so that light incident from said light source is output from a lower surface of said light pipe through said light output means;

10 a reflection layer disposed on said lower surface of said light pipe so that reflected light of said output light is transmitted through said upper surface of said light pipe; and

15 a liquid-crystal shutter disposed above said upper surface of said light pipe, said liquid-crystal shutter including liquid-crystal cells and at least one polarizing plate.

2. A liquid-crystal display device according to claim 1, wherein said light source disposed near to the incident side surface of said light pipe can be switched on and off.

3. A liquid-crystal display device according to claim 1, wherein said light pipe has, at its upper surface, said light output means comprising:

25 slopes facing said incident side surface and inclined at an angle of from 35 to 45 degrees with respect to a reference plane of said lower surface; and

flat surfaces inclined at a crossing angle of not larger than 10 degrees with respect to said reference plane,

wherein projected area of said flat surfaces on said reference plane is not smaller than 8 times as large as projected area of said slopes on said reference plane.

5           4.     A liquid-crystal display device according to claim 1, wherein said light output means on said upper surface of said light pipe has a repetition structure of continuous or discontinuous prism-like irregularities arranged at intervals of a pitch of from 50  $\mu$ m to 1.5 mm, each of said prism-like irregularities comprising:

10                 a short side surface constituted by a slope inclined downward from the incident side surface toward an opposite end of the incident side surface at an inclination angle of from 35 to 45 degrees with respect to a reference plane of said lower surface; and

15                 a long side surface constituted by a slope inclined at an inclination angle in a range of from 0 to 10 degrees, exclusive of 0 degree, with respect to said reference plane so that difference in the inclination angle among all of said slopes of the long side surface is within 5 degrees and the difference in the inclination angle between adjacent long side surfaces is within 1 degree,

20                 wherein projected area of the long side surfaces on said reference plane is not smaller than 8 times as large as projected area of the short side surfaces on said reference plane.

25           5.     A liquid-crystal display device according to claim 4, wherein a repetition pitch of said prism-like irregularities

is fixed.

6. A liquid-crystal display device according to claim  
4, wherein a projected width of each of said short side surfaces  
5 on said reference plane is not larger than 40  $\mu\text{m}$ .

7. A liquid-crystal display device according to claim  
4, wherein a ridgeline direction of said prism-like  
irregularities is within  $\pm 35$  degrees with respect to a  
10 reference plane of said incident side surface.

8. A liquid-crystal display device according to claim  
1, wherein incident light from said lower surface is transmitted  
through said upper surface at total light-rays transmissivity  
15 of not lower than 90 %.

9. A liquid-crystal display device according to claim  
1, wherein said reflection layer on the lower surface of said  
light pipe is made at least one of selected from the group  
20 consisting of gold, silver, aluminum, and a dielectric  
multilayer film.

10. A liquid-crystal display device according to claim  
1, wherein said reflection layer on the lower surface of said  
25 light pipe is in contact with said lower surface of said light  
pipe so as to be integrated with said light pipe.

11. A liquid-crystal display device according to claim

1, wherein said reflection layer on the lower surface of said light pipe reflects light while diffusing said light.

12. A light pipe comprising:

5 an incident side surface;  
an upper surface;  
a lower surface with which a reflection layer is integrated; and

light output means formed on said upper surface so that  
10 incident light from said incident side surface is output from said lower surface through said light output means, and reflected light of output light reflected by the reflection layer is transmitted through said upper surface,

wherein said light output means comprises:

15 slopes facing said incident side surface and inclined at an angle of from 35 to 45 degrees with respect to a reference plane of said lower surface; and

flat surfaces inclined at a crossing angle of not larger  
than 10 degrees with respect to said reference plane and  
20 provided so that projected area of said flat surfaces on said reference plane is not smaller than 8 times as large as projected area of said slopes on said reference plane.

13. A light pipe according to claim 12, wherein  
25 wherein said light output means has a repetition structure of continuous or discontinuous prism-like irregularities arranged at intervals of a pitch of from 50  $\mu\text{m}$  to 1.5 mm, each of said prism-like irregularities comprising:



17. A light pipe according to claim 12, wherein said light pipe transmits light through said upper surface at total light-rays transmissivity of not lower than 90 % when said light is incident from said lower surface in a condition that said  
5 light pipe does not have the reflection layer.

18. A light pipe according to claim 12, wherein said reflection layer on the lower surface of said light pipe is made at least one of selected from the group consisting of gold,  
10 silver, aluminum, and a dielectric multilayer film.

19. A light pipe according to claim 12, wherein said reflection layer on the lower surface of said light pipe is in contact with said lower surface of said light pipe so as to be  
15 integrated with said light pipe.

20. A light pipe according to claim 12, wherein said reflection layer on the lower surface of said light pipe  
reflects light while diffusing said light.